

# Notice of Allowability

Application No.

10/056,316

Examiner

Thomas H Parsons

Applicant(s)

DUBOUST ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the RCE filed 28 June 2004.
2. ☒ The allowed claim(s) is/are 1-4, 7-14, 16-35, 37-43 and 47-50.
3. ☒ The drawings filed on 22 January 2002 and 03 March 2003 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☐ All b) ☐ Some\* c) ☐ None of the:
    1. ☐ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
  6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
    - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.
    - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),  
Paper No./Mail Date \_\_\_\_\_
4. ☐ Examiner's Comment Regarding Requirement for Deposit  
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_\_
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_\_

***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 28 June 2004 has been entered.

**EXAMINER'S AMENDMENT**

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Attorney Keith Taboada on 18 August 2004.

The application has been amended as follows:

Claim 1, line 8, "the electrolyte" has been changed to --an electrolyte--; and,  
Claim 50, line 3, "the electrically" has been changed to --an electrically--.

***Reasons for Allowance***

2. The following is an examiner's statement of reasons for allowance:

**U.S. Patent No. 5,911,619** discloses in Figure 15 an electrochemical mechanical planarization apparatus wherein a wafer W is held on a carrier table CT such that the layer 18

faces a movable polishing head MPH, and shows an endpoint detector such as an optical reflectivity monitor including a light source LS (e.g., laser), a movable mirror MM and a position sensitive detector PSD which measures light intensity as a function of a position on the wafer.

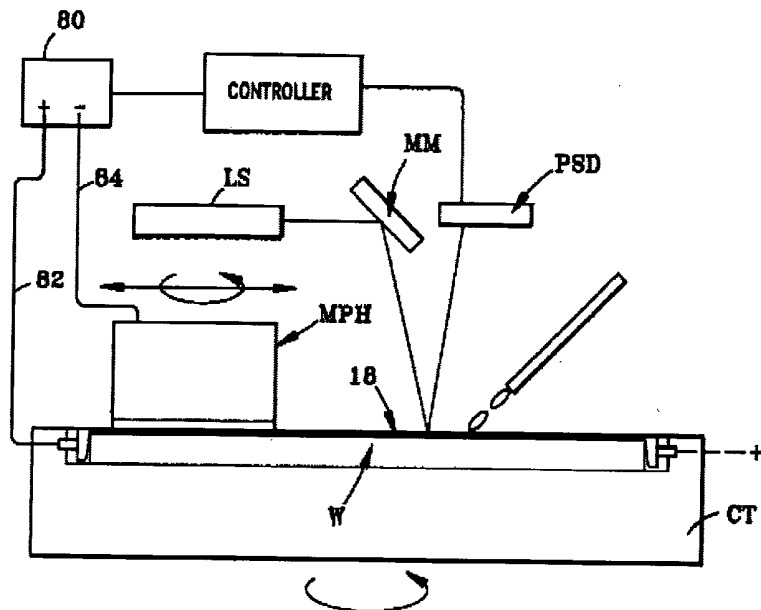


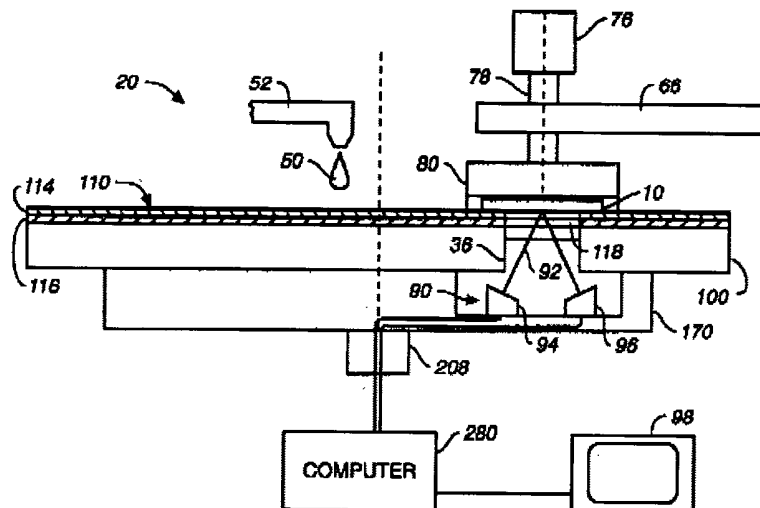
FIG. 15

When the detector receives a detector signal indicating that the thickness of the layer 18 is very thin, or has been removed, the detector signal is interpreted by the controller to command the supply 80 to decrease the magnitude of the electrical potential provided by the supply 80.

U.S. Patent No. 6,266,935 discloses in Figure 9 an aperture or hole formed in platen 100 and aligned with transparent strip 118 in polishing sheet 110. The aperture and transparent strip 118 are positioned such that they have a "view" of substrate 10 during a portion of the platen's rotation, regardless of the transnational position of the polishing head. An optical monitoring system 90 is located below and secured to platen 100, e.g., between rectangular platen 100 and platen base 170 so that it rotates with the platen. The optical monitoring system includes a light source 94 and a detector 96. The light source generates a light beam 92 which propagates

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through the aperture and transparent strip 118 to impinge upon the exposed surface of substrate 10.



**FIG. 9**

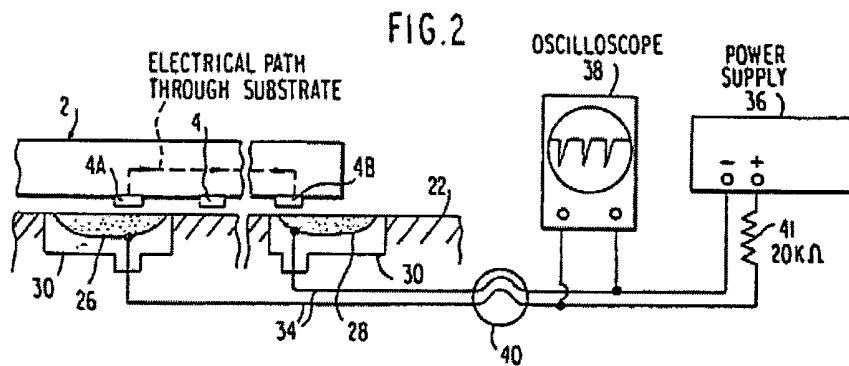
In operation, chemical mechanical polishing (CMP) apparatus 20 uses optical monitoring system 90 to determine the thickness of a layer on the substrate to determine the amount of material removed from the surface of the substrate, or to determine when the surface has become planarized. The computer 280 may be connected to light source 94 and detector 96. Electrical couplings between the computer and the optical monitoring system may be formed through rotary coupling 208. The computer may be programmed to activate the light source when the substrate overlies the window, to store measurements from the detector, to display the measurements on an output device 98, and to detect the polishing endpoint.

**U.S. Patent No. 6,368,184** discloses a method of polishing a conductive process layer of a wafer using a polishing pad of a polishing tool having at least one sender electrode and at least one response electrode disposed therein. A signal is provided to the at least one sender electrode. The signal provided to the at least one sender electrode is monitored with at least one of a group of the at least one response electrode, the at least one response electrode communicating with the at least one sender electrode through the conductive process layer of

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the wafer. Endpoint of the polishing process is determined based on the signal received by the at least one response electrode.

EP 0325753 discloses in FIG. 2, active and passive electrodes 26 and 28, respectively, each shown connected to a power supply 36 and to a storage oscilloscope or other suitable electronics 38 through a slip ring assembly 40. The active electrode 26 is connected to the positive terminal of the power supply 36 through the slip ring assembly 40 and through a resistor 41. The passive electrode 28 is connected to the negative terminal of the power supply 36 through the slip ring assembly 40. The power supply 36 is designed to generate a bias voltage of 0.4 V, and resistor 41 has a resistance, for example, of 450K $\Omega$  to limit the current (20  $\mu$ amps) supplied to the active electrode 26.



At the beginning of the planarization or polishing process, wafer 2 is covered with a layer of insulating material such as silicon dioxide. Since electrodes 26 and 28 initially contact only the insulating layer, an open circuit results. As the planarization process proceeds, the insulating layer is removed, exposing grounded or substrate contacting metal pads 4. When electrodes 26 and 28 both contact the exposed pads 4, a current path is formed through the substrate of the wafer 2.

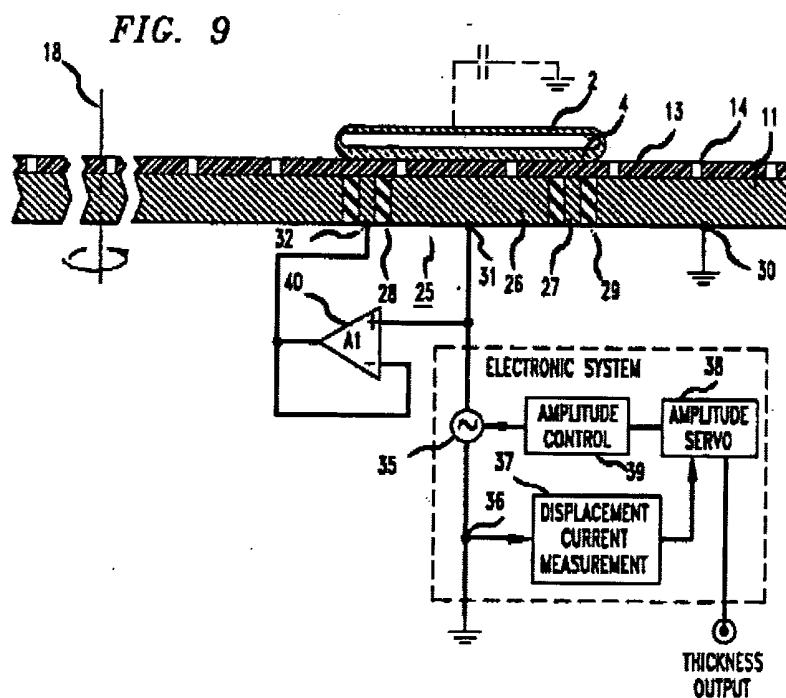
More specifically, a 20  $\mu$ amp current flows from metal 4A (which is in contact with electrode 26) to metal 4B (which is connected to electrode 28) through the interconnecting wiring and circuitry formed in the substrate of wafer 2. As the wafer passes over the electrode pulses or spikes appear on the screen of oscilloscope 38. The current supplied to electrode 26 is limited to 20  $\mu$ amps to prevent damage to the underlying circuitry.

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The pulses appearing on the screen of oscilloscope 38 indicate that the polish endpoint of the wafer 2 has occurred (e.g. metal points 4 are exposed).

**EP0455455** discloses an in situ monitoring technique and apparatus for chemical/mechanical planarization end point detection in the process of fabricating semiconductor or optical devices. The detection in the present invention is accomplished by means of capacitively measuring the thickness of a dielectric layer on a conductive substrate. The measurement involves the dielectric layer, a flat electrode structure and a liquid interfacing the article and the electrode structure. Polishing slurry acts as the interfacing liquid. The electrode structure includes a measuring electrode, an insulator surrounding the measuring electrode, a guard electrode and another insulator surrounding the guard electrode. In the measurement a drive voltage is supplied to the measuring electrode, and in a bootstrap arrangement to a surrounding guard electrode, thereby measuring the capacitance of the dielectric layer of interest without interfering effect from shunt leakage resistance.

In the system shown in FIG. 9, measuring electrode 26 is driven with an alternating voltage from oscillator 35.



The resulting displacement current flowing to the measuring electrode necessarily flows to ground through 35 itself, and its amplitude is measured at 36 and compared with a reference value at 38. Any resulting difference is then used at 39 to control the amplitude of oscillator 35, in such a way as to hold the displacement current itself constant. As a result the amplitude of the drive voltage to the measuring electrode is always precisely proportional to the thickness of the dielectric layer on the silicon slice. Guard electrode 27 is bootstrapped from the measurement electrode 26 by a unity gain follower amplifier (A1) 40.

In contrast, the instant invention is directed toward a method and apparatus wherein at least one of an increase in a voltage and a decrease in a current of an electrical signal is detected to determine the polishing endpoint which is neither taught nor suggested in the prior art references of record.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thomas H Parsons whose telephone number is (571) 272-1290. The examiner can normally be reached on M-F (7:00-4:30) First Friday Off.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Thomas H Parsons  
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